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The Global Vaccine Action Plan – insights into its utility, application, and ways to strengthen future plans

Michael A. Daugherty [a,*], Alan R. Hinman [b], Stephen L. Cochi [c], Julie R. Garon [a], Lance E. Rodewald [d], Glen Nowak [e], Mark A. McKinlay [b], Eric E. Mast [c], Walter A. Orenstein [a,f]

[a] Department of Medicine, Emory University School of Medicine, Atlanta, GA, United States
[b] Center for Vaccine Equity, Task Force for Global Health, Decatur, GA, United States
[c] Global Immunization Division, Center for Global Health, Centers for Disease Control and Prevention, Atlanta, GA, United States
[d] National Immunization Program, Chinese Center for Disease Control and Prevention, Beijing, China
[e] Center for Health & Risk Communication, Grady College of Journalism and Mass Communication, University of Georgia, Athens, GA, United States
[f] Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA, United States

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ABSTRACT

Background: The pace of global progress must increase if the Global Vaccine Action Plan (GVAP) goals are to be achieved by 2020. We administered a two-phase survey to key immunization stakeholders to assess the utility and application of GVAP, including how it has impacted country immunization programs, and to find ways to strengthen the next 10-year plan.
Methods: For the Phase I survey, an online questionnaire was sent to global immunization stakeholders in summer 2017. The Phase II survey was sent to regional and national immunization stakeholders in summer 2018, including WHO Regional Advisors on Immunization, Expanded Programme on Immunization managers, and WHO and UNICEF country representatives from 20 countries. Countries were selected based on improvements (10) versus decreases (10) in DTP3 coverage from 2010 to 2016.
Results: Global immunization stakeholders (n = 38) cite global progress in improving vaccine delivery (88%) and engaging civil society organizations as advocates for vaccines (83%). Among regional and national immunization stakeholders (n = 58), 70% indicated reaching mobile and underserved populations with vaccination activities as a major challenge. The top ranked activities for helping country programs achieve progress toward GVAP goals include improved monitoring of vaccination coverage and upgrading disease surveillance systems. Most respondents (96%) indicated GVAP as useful for determining immunization priorities and 95% were supportive of a post-2020 GVAP strategy.
Conclusions: Immunization stakeholders see GVAP as a useful tool, and there is cause for excitement as the global immunization community looks toward the next decade of vaccines. The next 10-year plan should attempt to increase political will, align immunization activities with other health system agendas, and address important issues like reaching mobile/migrant populations and improving data reporting systems.

1. Introduction

In May 2012, the Global Vaccine Action Plan (GVAP) 2011–2020 was endorsed by 194 Member States at the 65th World Health Assembly. GVAP was a product of the Decade of Vaccines Collaboration, an unprecedented effort led by the Bill & Melinda Gates Foundation, the World Health Organization (WHO), Gavi the Vaccine Alliance, the United Nations Children's Fund (UNICEF), and the U.S. National Institute of Allergy and Infectious Diseases to extend the full benefits of vaccines to all people by 2020 and beyond [1]. It was estimated that substantial progress toward

Abbreviations: GVAP, The Global Vaccine Action Plan; WHO, World Health Organization; UNICEF, United Nations Children's Fund; SAGE, Strategic Advisory Group of Experts on Immunization; DTP3, three doses of diphtheria-tetanus-pertussis vaccine; NITAG, National Immunization Technical Advisory Group; EPI, Expanded Programme on Immunization; CSOs, Civil Society Organizations; RVAPs, Regional Vaccine Action Plans; VPD, vaccine-preventable disease; SIAs, supplemental immunization activities; PCV, pneumococcal conjugate vaccine.

* Corresponding author at: Emory Vaccine Center, 1462 Clifton Rd NE, DSB 446, Atlanta, GA 30322, United States.
E-mail address: michael.daugherty@emory.edu (M.A. Daugherty).

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GVAP goals could potentially avert 25 million vaccine-preventable deaths by the end of the decade [2].

In its 2016 Midterm Review of GVAP, however, the WHO Strategic Advisory Group of Experts on Immunization (SAGE) concluded that strident efforts by all countries and immunization stakeholders were needed to catch up and achieve GVAP goals [3]. The only GVAP 2015 target that had been reached was introduction of new and underutilized vaccines (Table 1, Target 6). By the end of 2015, three countries had not interrupted wild poliovirus transmission (Afghanistan, Nigeria, Pakistan); three WHO regions had not achieved neonatal tetanus elimination (African, Eastern Mediterranean, Western Pacific); only one WHO region had achieved measles and rubella elimination (Americas). Further, of the 67 countries that had not achieved 90% coverage with the third dose of diphtheria-tetanus-pertussis vaccine (DTP3) since 2010, 26 reported no change in coverage and 25 reported a net decrease in coverage [3].

We administered a two-phase survey to key immunization stakeholders to assess the utility and application of GVAP and to find ways to strengthen the next 10-year plan. The purpose of the Phase I survey was to learn how global immunization stakeholders viewed progress toward GVAP goals and to determine which GVAP-related activities were perceived as most useful for country immunization programs. Additionally, findings from the Phase I survey helped prioritize themes and generate questions for the Phase II survey. The purposes of the Phase II survey were to identify challenges and useful activities for country immunization programs as well as to assess the usefulness of GVAP and useful characteristics of a post-2020 GVAP strategy. Our findings provide evidence for how global immunization stakeholders can best support country immunization programs in the coming years and develop future plans.

2. Methodology

2.1. Phase I survey design

The Phase I survey was designed for global immunization stakeholders (i.e. individuals involved in global immunization efforts, whether affiliated with a global or national organization). Organizations involved in development of GVAP were consulted to identify potential respondents (Supplemental Material, Appendix A). Points of contact were identified within each organization as a starting point for respondent recruitment. A convenience sample of 88 stakeholders was sent an introductory email describing the survey purpose and dissemination plans. The email included a link to an online questionnaire administered through SurveyMonkey (San Mateo, California, USA). The survey link was active for three weeks (June 16–July 7, 2017). Respondents were encouraged to forward the survey link to colleagues or to recommend colleagues in the survey itself. The survey consisted of 17 questions, including multiple choice, drop-down matrix, allocation/prioritization, and free-text/open-ended types (Supplemental Material, Appendix B).

2.2. Country selection for Phase II survey

Twenty countries were selected for the Phase II survey. Selection criteria for countries included a ≥5% difference in DTP3 coverage between 2010 and 2016 and a population size >4 million; preference was given to countries free of conflict and/or having a large number of unvaccinated children. Eighteen countries were selected based on these criteria; nine were classified as "improving coverage countries" (≥5% increase in DTP3 coverage) and nine as "declining coverage countries" (≥5% decrease) (Fig. 1) [4]. Because of having large numbers of unvaccinated children, Afghanistan (+2% DTP3) was included as an improving coverage country and Indonesia (−2% DTP3) was included as a declining coverage country. Of countries surveyed, six were from WHO's African Region; four from the Region of the Americas; four from the European Region; and two each from the other three Regions. All selected countries except Ukraine have established a National Immunization Technical Advisory Group (NITAG) [5].

2.3. Phase II survey design

The Phase II survey was designed for regional and national immunization stakeholders, including the six WHO Regional Advisors on Immunization and Expanded Programme on Immunization (EPI) managers, WHO country representatives, and UNICEF country

Table 1
Recommended goals and goal-related targets of the Global Vaccine Action Plan 2011–2020 (Annex 1, page 90), including status of progress toward targets by the end of 2015 [2].

Goal	2015 Target	2015 Target achieved?	2020 Target
Achieve a world free of poliomyelitis	1. Interrupt wild poliovirus transmission globally (by 2014)	No	A. Certification of poliomyelitis eradication (by 2018)
Meet global and regional elimination targets	2. Neonatal tetanus eliminated in all WHO regions	No	B. Measles and rubella eliminated in at least five WHO regions
	3. Measles eliminated in at least four WHO regions	No	
	4. Rubella/congenital rubella syndrome eliminated in at least two WHO regions	No	
Meet vaccination coverage targets in every region, country, and community	5. Reach 90% national coverage and 80% in every district or equivalent administrative unit with three doses of diphtheria-tetanus-pertussis-containing vaccines	No	C. Reach 90% national coverage and 80% in every district or equivalent administrative unit with all vaccines in national programs, unless otherwise recommended
Develop and introduce new and improved vaccines and technologies	6. At least 90 low-income and middle-income countries have introduced one or more new or underutilized vaccines	Yes*	D. All low-income and middle-income countries have introduced one or more new or underutilized vaccines
			E. Licensure and launch of vaccine or vaccines against one or more major currently non-vaccine preventable diseases
			F. Licensure and launch of at least one platform delivery technology
Exceed the Millennium Development Goal 4 target for reducing child mortality	7. Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate (Target 4.A) [from 93 deaths per 1000 live births to 31/1000, global average]	No	G. Exceed the Millennium Development Goal 4 target for reducing child mortality [<31/1000]

* Ninety-nine low- and middle-income countries have introduced at least one new and under-utilized vaccine (excluding IPV) to their national immunization program and sustained use for at least 12 months, with a total of 160 vaccine introductions in these countries.

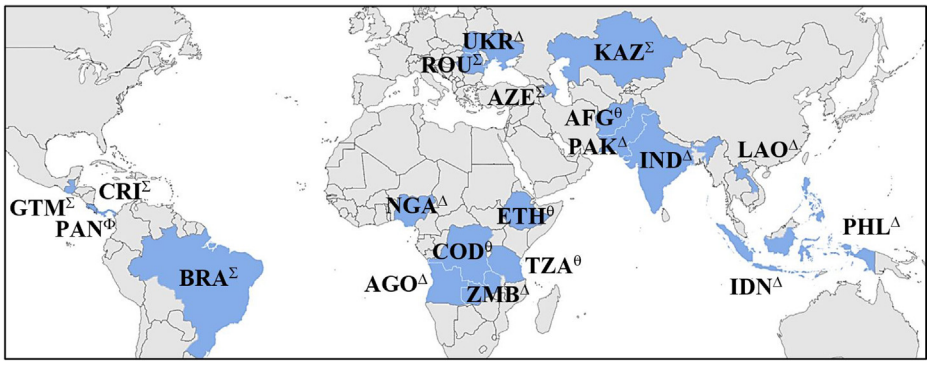

Fig. 1. Ten countries selected for Phase II surveys were categorized as improving coverage countries (Afghanistan [AFG], Azerbaijan [AZE], Cost Rica [CRI], the Democratic Republic of Congo [COD], Ethiopia [ETH], India [IND], Lao People's Democratic Republic [LAO], the Philippines [PHL], the United Republic of Tanzania [TZA], and Zambia [ZMB]) and ten as declining coverage countries (Angola [AGO], Brazil [BRA], Guatemala [GTM], Indonesia [IDN], Kazakhstan [KAZ], Panama [PAN], Pakistan [PAK], Nigeria [NGA], Romania [ROU], and Ukraine [UKR]). $^{\theta}$Low-income country. $^{\Delta}$Lower-middle-income country. $^{\Sigma}$Upper-middle-income country. $^{\Phi}$High-income country.

representatives/Health Chiefs from 20 countries. WHO provided contact information for EPI managers, Regional Advisors, and WHO country representatives; UNICEF provided contact information for its country representatives. The EPI manager and Regional Advisor surveys were sent via email and respondents were able to complete the surveys over the telephone (29% of responses) or email (71%). The EPI manager survey was sent out on April 2, 2018 and the Regional Advisor survey was sent on May 1, 2018, with reminder emails sent biweekly. Each survey was open for 12 weeks. The abbreviated survey for country representatives was sent via SurveyMonkey and was open for eight weeks (June 11–August 8, 2018).

Survey questions were tailored to fit the responsibilities relevant to EPI managers, Regional Advisors, and WHO and UNICEF country representatives. The EPI manager survey included 27 questions, the Regional Advisor survey included 21 questions, and the country representative survey included nine questions. The surveys consisted of multiple choice, drop-down matrix, allocation/prioritization, and free-text/open-ended questions (Supplemental Material, Appendix B). On average, EPI managers and Regional Advisors took 20–50 min to complete the survey and country representatives took 10–15 min to complete the abbreviated survey. As incentive for completing the survey, EPI managers and Regional Advisors received a copy of *Plotkin's Vaccines 7th edition* (2018). Surveys were available in English, Lao, Portuguese, Russian, and Spanish.

2.4. Data analysis

Multiple-choice, matrix, and ranking responses were converted into average scores ("don't know" responses were not included in the calculations) in order to compare relative importance among factors. All available responses for each question were used in analysis. Responses were stratified by country status (i.e. improving vs. declining) and job role, and, in general, differences were included if statistically significant ($p \leq 0.05$). Data analyses were performed using SurveyMonkey Basic Statistics software and SAS 9.4 (SAS Institute, Cary, NC). Open-ended responses were read in detail and categorized by common themes, informative points, or areas of strong opinion. Quotes highlighted in this report were de-identified and represent a diverse array of perspectives and viewpoints.

3. Results from Phase I survey – insights from global immunization stakeholders

We received responses from 38 global immunization stakeholders. A true response rate for the Phase I survey could not be calculated since respondents were anonymous, could forward the survey link to colleagues, and the number and participation of those to whom it was forwarded is unknown. Because of how the survey was conducted, we cannot describe characteristics of the Phase I respondents.

3.1. Progress toward GVAP goals and activities

Survey participants were asked to characterize global progress toward GVAP goals. Only two of the seven GVAP 2020 targets (introduction and licensure of one or more new vaccines, D and E in Table 1) were perceived as "likely to be achieved" by >50% of respondents whereas three targets (polio eradication, measles and rubella elimination, and reaching national coverage targets) were perceived as "unlikely to be achieved" by >60% of respondents.

Survey participants were asked to characterize global progress to date toward 22 activities adapted from the SAGE recommendations in the Midterm Review of GVAP [3]. These activities were grouped into three categories: leadership, system strengthening, and accountability (Supplemental Material, Appendix C). In the Leadership category (n = 29 responses), "Having countries establish NITAGs" and "Having Ministers become stronger advocates for vaccines" were identified as achieving good progress (versus no or some progress) by 40% and 24% of respondents, respectively, while 21% of respondents identified "Getting more countries to make greater investments in disease surveillance" as achieving no progress. In system strengthening, 88% of respondents indicated that some or good progress had been made toward "Improving vaccine delivery and supply chain systems" (n = 26). In accountability, 83% of respondents indicated that some or good progress had been made toward "Greater use of social mobilization and engagement of Civil Society Organizations (CSOs) as advocates for vaccines and vaccination activities" (n = 25). The most no progress votes (29%) were for "More efforts directed toward measles elimination."

3.2. Activities perceived as most useful for country immunization programs

To get a sense of which activities were perceived as most useful for country immunization programs, survey participants were asked to distribute resources across SAGE-recommended activities. The allocation exercise was within each category of recommendations and was not designed to compare usefulness among categories. In each category, the top three activities identified by respondents garnered >50% of resources. In the leadership cate-

gory, the activities that were viewed as being most useful in achieving GVAP goals were:

1. Getting more countries to make greater investments in routine immunization (26% of total resources allocated).
2. Getting more countries to make greater investments in disease surveillance (18%).
3. Getting more countries to upgrade systems necessary to achieve high immunization coverage (15%).

In the system-strengthening category, the activities that were viewed as being most useful in achieving GVAP goals were:

1. Greater implementation of interventions in countries with <80% DTP3 coverage (28%).
2. Getting more countries to use up-to-date data (e.g., disease surveillance) to guide immunization program decisions (18%).
3. Improving vaccine delivery and supply chain systems (18%).

In the accountability category, the activities that were viewed as being most useful in achieving GVAP goals were:

1. Greater use of social mobilization and engagement of CSOs as advocates for vaccines and vaccination activities (23%).
2. Greater advocacy by global partners for the urgency and value of accelerating global progress toward GVAP goals (19%).
3. More efforts by international agencies, donors, vaccine manufacturers, and governments to assist countries with displaced populations or in humanitarian crises (18%).

4. Results from Phase II survey – Insights from regional and national immunization stakeholders

Responses were received from 18/20 EPI managers (90% response rate), 6/6 Regional Advisors (100%), and 34/40 WHO and UNICEF country representatives (85%) who were asked to participate in the survey. The overall response rate was 88% (58/66). All eight non-responders were from declining coverage countries. All countries had at least one respondent.

4.1. Challenges faced by country immunization programs

Survey participants were asked to rate the severity of 26 managerial, operational, and technical challenges that country immunization programs might have faced in recent years while trying to achieve GVAP goals, from 1 (not a challenge) to 5 (major challenge). Table 2 shows the ten most severe and/or common challenges. Seventy percent of respondents rated "Being able to reach mobile and/or underserved populations with vaccination" as a major challenge [average score = 3.98, top-ranked challenge]. Differences among average scores were generally small (Supplemental Material, Appendix D). Respondents from declining coverage countries indicated that "Getting enough people with needed expertise involved in the immunization program" and "Vaccine shortages and stockouts" were more of a challenge compared to respondents from improving coverage countries [3.63 vs 2.90, p = 0.04; 3.30 vs 2.43, p = 0.03; respectively].

EPI managers and Regional Advisors were asked to rate whether the 26 challenges had gotten worse (score = 1), stayed the same (score = 2), or improved (score = 3) in the last two years. "Being able to increase public demand for vaccines and vaccination services through advocacy activities" [2.53] was perceived to have most improved for country immunization programs (i.e. become less of a challenge) while "Getting the needed level of financial support from global immunization stakeholders for program implementation" received the lowest average score [1.83]. Respondents from declining coverage countries indicated the most improvement in "Being able to quickly and effectively respond to vaccine-preventable disease cases and outbreaks" [2.83]. They also indicated greater improvement in "Getting the needed level of

Table 2
Top ten (of 26) most severe challenges ranked by Phase II respondents (n = 58), with appropriate distributions and weighted averages ("don't know" responses were not included in calculations).

Challenges	Distribution	Weighted average
1. *Being able to effectively reach mobile and/or underserved populations with vaccination*	1 2 3 4 5 dk 3 3 11 14 25 2	3.98
2. *Getting reporting systems to generate needed, timely, and valid vaccination coverage data*	1 2 3 4 5 dk 5 7 16 13 15 2	3.46
3. *Competing health priorities*	1 2 3 4 5 dk 9 3 14 11 16 5	3.42
4. *Being able to increase public demand for vaccines through advocacy activities*	1 2 3 4 5 dk 6 4 19 16 10 3	3.36
5. *Other surveillance and reporting systems issues*	1 2 3 4 5 dk 3 9 18 14 10 4	3.35
6. *Being able to quickly and effectively respond to vaccine-preventable disease cases and outbreaks*	1 2 3 4 5 dk 6 12 10 12 15 3	3.33
7. *Getting the needed level of financial support from domestic private partners for program implementation*	1 2 3 4 5 dk 9 5 9 5 16 14	3.32
8. *Being able to effectively address vaccine hesitancy*	1 2 3 4 5 dk 8 7 14 12 14 3	3.31
9. *Being able to address/respond to vaccine safety issues (e.g., AEs)*	1 2 3 4 5 dk 6 9 15 13 12 3	3.29
10. *Getting surveillance systems to generate needed, timely, and valid data*	1 2 3 4 5 dk 1 2 11 16 18 3	3.27
	1 2 3 4 5 dk	

financial support from domestic private partners for program implementation" compared to respondents from improving coverage countries [2.40 vs 1.67, p = 0.007].

In a series of open-ended questions, EPI managers were asked to identify and describe efforts that had effectively addressed challenges faced by their country immunization programs. For reaching mobile and underserved populations, 81% of respondents mentioned the importance of targeted/supplemental campaigns, "collaboration" (e.g., with in-country partners, CSOs), and/or mobile health teams (Box 1).

Box 1. Notable open-ended responses from EPI managers (n=16, 2 no response) for reaching mobile and underserved populations with vaccination activities. Responses were de-identified.

1. "We have a short action plan guide that is carried out with the Ministry of Aerospace ('Drop Operation'), in which missions are undertaken to take healthcare teams to areas of difficult access to carry out vaccination."
2. "Since 2016 the program partnered with UNICEF in implementing the Reaching Every District strategy with the objective to find the missed children in the communities."
3. "We recognized the potential that civil society plays in our HPV demonstration and supported the creation of the Civil Society Immunization Platform (SCIP). This has significantly helped to facilitate better community engagement."
4. "We revised WHO's Reaching Every District strategy to focus on absolute numbers [of unvaccinated children] instead of coverage; with PATH (collaboration of Better Immunization Data), we introduced an electronic immunization registry implemented in nomadic populations and hard-to-reach areas; with Red Cross, we implemented Baby Tracking where community volunteers went house to house to track for defaulters and advocate for immunization services."

Most EPI managers (75%) mentioned dealing with vaccine stockouts as a significant challenge, and all reported taking action to improve vaccine supply situations. Interventions included modernizing the supply chain (e.g., adding more storage/distribution facilities), using forecasting systems, ordering vaccines 6–18 months in advance of need, developing stockpiles, and purchasing vaccines through cooperatives like the Revolving Fund or through UNICEF. Sixty-eight percent of EPI managers acknowledged vaccination hesitancy as a challenge, with 50% noting that hesitancy was limited to specific regions or groups. Helping to identify misinformation or rumors, engaging opinion leaders (e.g., religious, political, celebrities) to influence public opinion, and developing communication plans for responding to adverse events following immunization were mentioned as strategies to address hesitancy.

Regional Advisors were asked to describe challenges they have commonly observed among countries in their region; notable responses are shown in Box 2. In general, Regional Advisors view country ownership of GVAP and immunization services as a common challenge, along with coordination issues (e.g., vaccine introduction without sufficient technical support) and competing priorities.

Box 2 .Notable open-ended responses from Regional Advisors (n=6) related to common challenges they have seen occur among countries in their region in recent years.

1. "Funding partners don't coordinate together and they want to have direct contact with countries (direct support without sufficient experience or knowledge of country or without talking with WHO Regional Office). For example, countries will take financial support for introducing new vaccines but don't have the capacity to do so without WHO coordination."
2. "We don't have the political commitment because of competing priorities, notably non-communicable diseases, coupled with the belief that vaccine-preventable diseases are behind us... Since countries are ping-ponging measles cases, no one can truly get behind saying that they will eliminate the disease."
3. "...Country ownership is still a challenge in many places. It is difficult to continue to advocate for immunization strengthening alone when countries are having challenges with the overall health system strengthening. A coordinated approach through primary health care (PHC) revitalization may be required in the future if we want to get lasting results."
4. "A big challenge is gathering political engagement for countries. Surveillance is so important because telling countries to increase from 80% DTP3 coverage to 90% is not as good as showing them the areas where diphtheria is a big issue."

4.2. Activities useful for country immunization programs

Survey participants were asked to rate the usefulness of 22 activities adapted from the SAGE midterm recommendations, from 1 (not useful) to 5 (very useful). Respondents were asked to not take into account how difficult each activity would be to implement. Table 3 shows the ten activities considered most useful. The top ranked activities included improved monitoring of vaccination coverage and upgrading surveillance systems. Overall, most respondents (78%) rated each activity as somewhat or very useful (4 or 5 score). Even the activity perceived to be least useful ("Getting more domestic private partners involved in vaccination efforts") received an average score that indicated some utility [3.81] (Supplemental Material, Appendix E).

EPI managers and Regional Advisors were asked to indicate the usefulness of technical support activities provided by global immunization partners. Of 12 technical support activities that these partners could provide to country immunization programs (Supplemental Material, Appendix F), the perceived most useful (in rank order) were:

How to strengthen surveillance and reporting systems and data quality.
How to monitor vaccine supply and delivery (e.g., cold chain evaluation).
How to use data to inform immunization strategies or actions;
How to better educate EPI professionals [tie].

4.3. Usefulness of GVAP

EPI managers and country representatives were asked to indicate how useful GVAP has been for strengthening their country's immunization efforts. Most (96%) indicated that GVAP was "somewhat useful" or "very useful" for determining immunization

Box 3. Notable open-ended responses from Regional Advisors (n=6) related to the usefulness of GVAP at the regional level. One response not included (see text).

1. ''GVAP is a powerful tool and was translated into [our RVAP] that was endorsed by all Ministers of Health. This regional endorsement gave a special impetus to all countries to align their national immunization plans with [our RVAP]."
2. ''It has helped increase global vaccination efforts, keep track of objectives/goals (i.e. Monitoring & Evaluation framework), and increase advocacy for our goals (i.e. clear messaging and hierarchy for advocacy within partnerships and between regional and senior management). For keeping track of where we are globally, it has been very powerful."
3. ''It helped us enormously to develop our RVAP. However, GVAP was not sufficient in allowing me to be regionally specific. It is not ambitious enough to meet the needs of our RVAP. I used GVAP as a framework and elaborated on much more ambitious and specific goals and targets. GVAP led the global prioritization of issues."
4. ''It has been pretty useful for us and it has been the central framework for which comprehensive multi-year plans (cMYPs) and national action plans have been developed. It has helped to put together a monitoring framework and garnered indirect political commitment around the action plans. It has been converted by us into more concrete timelines and regional goals."
5. ''It is extremely useful for us as a central framework and for providing monitoring indicators. But it has been difficult to translate at the regional level. The weakness is that it was centered around immunization coverage and increasing coverage and less on the utility of surveillance guiding immunization."

program priorities. Sixty-eight percent of respondents indicated that GVAP ''accelerated the implementation of national immunization activities" and none indicated that GVAP ''slowed down implementation of national immunization activities." All but one EPI manager indicated that it accelerated immunization activities (Fig. 2). In contrast, only 56% of WHO and UNICEF country representatives indicated likewise ($p = 0.005$).

In response to an open-ended question, EPI managers and country representatives responded that GVAP served them best by (1) garnering global and local political commitments, (2) setting a clear vision and hierarchy for national immunization goals/issues, and (3) advocating for the importance and benefits of vaccination activities. Five Regional Advisors indicated that GVAP has been useful at the regional level, while one said, ''GVAP has no clear audience and no clear implementation strategies." As shown in Box 3, Regional Advisors found GVAP to be especially useful as a framework for developing regional and national action plans (4 responses), monitoring or ''keeping track" of global progress (3 responses), and prioritizing advocacy efforts (2 responses). However, two respondents mentioned that GVAP was difficult to translate into their Regional Vaccine Action Plans (RVAPs) (Box 3, quotes 3 and 5).

4.4. Useful characteristics of a post-2020 GVAP strategy

Ninety-five percent of EPI managers and Regional Advisors were supportive of a new or updated GVAP strategy for 2021–2030. Respondents commonly noted that a new strategy would be most helpful if it were able to increase ''political will" and secure ''commitments" from stakeholders and high-level country authorities (e.g., Ministers of Health) (62%), strengthen surveillance infrastructure (43%), and foster greater public demand for vaccines (29%).

In regards to specific components of a post-2020 GVAP strategy, respondents suggested that the new strategy provide (a few) global targets (Box 4, quotes 1–3) while putting responsibility on the regional plans to develop specific strategies and actions for achieving the global targets (Box 4, quotes 4–6). Further, respondents indicated that the new strategy should touch on immunization as a platform for the ''broader health system development agenda" (Box 4, quote 7), which includes initiatives like the Global Health Security Agenda, Sustainable Development Goals, and universal health coverage [6].

Box 4. Notable open-ended responses from EPI managers and Regional Advisors (n=21, 3 skipped) related to useful components and characteristics of a post-GVAP strategy.

1. [EPI] ''Providing targets would be very, very important because they improve demand for us. And providing targets for our Interagency Coordinating Committee (ICC) is very useful because it motivates them and sets finances for us from ICC. ICC then sets the rules for our government."
2. [EPI] ''It is so important that there are specific targets, clear objectives, and of course political will."
3. [EPI] ''It's important to see the objectives that were in the previous GVAP, and work on the ones that are the most relevant and achievable. When you propose too many targets it causes difficulties, so it's better to offer a few objectives that can be reached."
4. [RA] ''GVAP should prepare the vision and common goals for member states to achieve. But how to achieve these goals and vision should be prepared by each region."
5. [RA] ''[Let] each region lead first, provide the strategies, and then GVAP can consolidate support for regional goals... we know that all regions focus on many of the same goals (i.e. measles/rubella/polio elimination/eradication). Regional goals will be similar, but the strategies should be very region-specific and will probably be very different. Regional Offices can come up with long-term and better strategies. We don't want detailed implementation strategies in the new GVAP for each region."
6. [RA] ''We are in danger of missing the bus here. I would have thought we would already be heavily invested in regional vaccine action plans. GVAP is a light document that should pick 4 or 5 indicators to measure global progress, that's it. The rest of document is not appropriate... We really just need key indicators. Drive the regions to develop their own plans and invest heavily in them; they don't have to be in the same format. Let the regions set the other region-specifics (i.e. goals and methods)."
7. [RA] ''It will be important that this global/regional framework be a platform that will promote the integration with Primary Health Care (PHC) interventions and look at the broader health system development agenda. The issue of strong surveillance linked to the global security agenda in order to tackle new emerging threats needs to be central to the development of the next 10-year plan."
8. [EPI] ''The new strategy should secure domestic and foreign commitments for national immunization, allow for lower-level (subnational) monitoring, be in tandem with the SDGs, and come with committed resources connected to the proposed targets."

Table 3
Top ten (of 22) most useful activities ranked by Phase II respondents (n = 58), with appropriate distributions and weighted averages ("don't know" responses were not included in calculations).

Activities	Distribution	Weighted average
1. *Improved monitoring of vaccination coverage*	0 0 6 8 43 1 / 1 2 3 4 5 dk	4.65
2. *Upgrading surveillance systems (e.g., disease detection, data reporting)*	0 0 3 15 38 2 / 1 2 3 4 5 dk	4.63
3. *Getting the Ministers of Health and Finance and other political leaders to become stronger advocates of immunization*	2 0 3 7 45 1 / 1 2 3 4 5 dk	4.63
4. *Adopting or enforcing laws that secure immunization program funding each year*	0 0 5 17 34 2 / 1 2 3 4 5 dk	4.52
5. *Monitoring vaccine delivery and supply chains*	0 1 6 14 34 3 / 1 2 3 4 5 dk	4.47
6. *Improving the vaccine supply chain*	1 2 4 12 37 2 / 1 2 3 4 5 dk	4.46
7. *Developing a communication and crisis management plan for when AEFIs occur*	0 0 9 13 33 3 / 1 2 3 4 5 dk	4.44
8. *Conducting a cold chain needs assessment and developing a rehabilitation plan*	0 1 6 17 31 3 / 1 2 3 4 5 dk	4.42
9. *Training health workers on vaccine injection/disposal safety and clinical skills*	0 3 5 13 32 5 / 1 2 3 4 5 dk	4.40
10. *Visible efforts to educate the general public about the safety of recommended vaccines*	0 1 7 17 32 1 / 1 2 3 4 5 dk	4.40

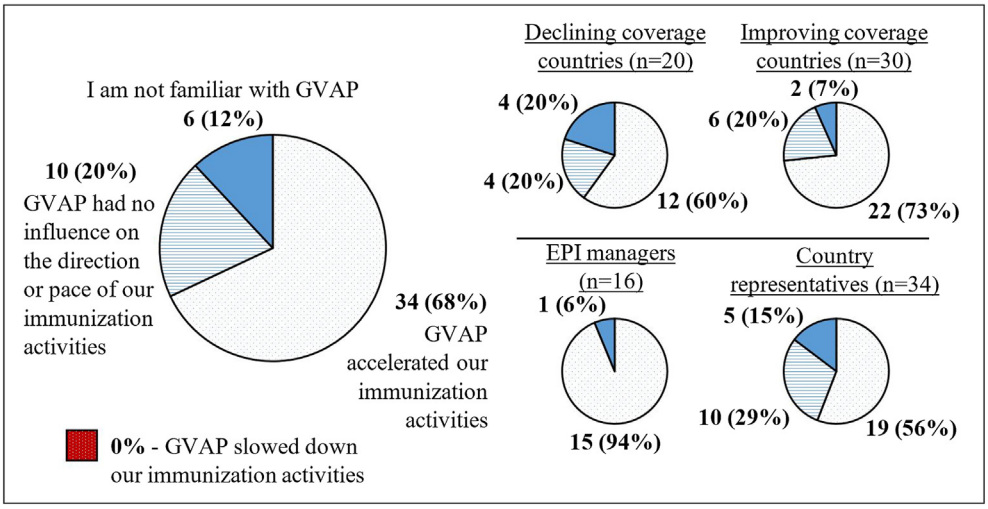

Fig. 2. Overall and stratified results from EPI managers and country representatives (n = 50, 2 skipped) when asked, "How has GVAP impacted your country's immunization program?".

5. Discussion

Our surveys found that global immunization stakeholders believe that GVAP disease goals are unlikely to be met by 2020, and that disease surveillance improvement, while important, has made little progress. The biggest challenges facing country immunization programs were reaching mobile and underserved populations and having valid vaccination coverage data. In particular, respondents from declining coverage countries indicated having a sufficient number of skilled staff involved in their immunization program as a major challenge. GVAP was seen as useful for accelerating immunization program activities, and the most useful GVAP-related activities included better monitoring of vaccination coverage, upgrading disease surveillance systems, and finding political leaders to advocate for immunization. Most respondents were supportive of a post-2020 GVAP strategy, with hopes that it will help increase political will and align immunization activities with other health system agendas.

Respondents clearly see the value in high-quality disease surveillance and data reporting systems. However, respondents also recognized vaccine-preventable disease (VPD) surveillance as an area of concern; 21% of global stakeholders saw "no progress"

in this area and regional and country respondents ranked VPD surveillance as the second-highest challenge. At the global level, WHO and UNICEF have recognized the need to improve coverage assessment methods and identify valid and affordable techniques for countries [7]. Our survey reinforces the need for such technical support.

As cases and outbreaks of VPDs continue to occur, it is critical that countries have quality data and are able to use data to locate areas of low vaccination coverage (e.g., hard-to-reach areas, pockets of resistance to vaccination), inform vaccination strategies, and motivate program funding. GVAP and annual GVAP assessments by SAGE highlight the issue of poor data quality (e.g., low reporting sensitivity), specifically for measles surveillance [8,9]. Global immunization stakeholders could, for example, help countries set up accredited laboratory networks or provide more technical training for national surveillance teams (e.g., for properly submitting data through systems like the WHO Joint Reporting Form). Activities for improving data quality at the national and district level may include using supplemental immunization activities (SIAs) to gather data on unvaccinated groups or working with CSOs to gather data and help assess vaccination barriers.

Another common concern among survey respondents was implementing vaccination activities among mobile and migrant populations and in hard-to-reach or conflict-afflicted areas. >68 million people—almost 1% of the world population—left their homes due to violence or persecution in 2017 [9]. Innovative strategies are needed to reach these groups, which are at risk of being missed by routine immunization services and vaccination campaigns [10,11]. Further, vaccination hesitancy was mentioned as a common barrier and reason for undervaccinated communities. Identifying misinformation, engaging leaders to influence public opinion, and developing risk communication plans after adverse events or controversies (e.g., Dengvaxia controversy in the Philippines [12]) will be important steps toward combating hesitancy and strengthening vaccination acceptance in the future.

Respondents indicated that GVAP has been useful for getting political leaders to become stronger advocates of immunization, while noting that they would like to see GVAP and global stakeholders do a better job of securing commitments for annual immunization program funding (e.g., having a Resolution signed by Member States). Financing immunization activities and vaccines is especially a problem for Gavi-graduating countries [13]. Non-Gavi middle-income countries are self-financing and do not benefit from Gavi preferential pricing or Gavi-financed technical support; these funding disadvantages have delayed introduction of vaccines like pneumococcal conjugate vaccine (PCV) and are a concern for program sustainability [9].

Our survey results generally align with those of previous surveys on GVAP. In 2017, MMGH Consulting conducted interviews with global immunization stakeholders and found that advocacy and communication of roles from the global to country level was one of the weakest aspects of GVAP [14]. Stakeholder input indicated that "Despite the overall plan's quality, knowledge of GVAP is still limited outside the [global] immunization community." Our results support this conclusion (Fig. 2).

Another survey on GVAP and the development of a post-2020 GVAP strategy was carried out by WHO in June 2018 [15]. This survey also found disease surveillance to be an important issue in the coming decade, and that the next 10-year plan should help align VPD-specific and health system approaches to build strong immunization programs with a primary health care perspective [16]. Further, the survey found that respondents would prefer a new strategy that is brief versus lengthy (e.g., "a short and crisp document would be better than a long and unwieldy one" [15]); our results suggested likewise (Box 4, quotes 3 and 6).

Our study has several limitations. First, overall averages may mask differences among countries, and, for some questions, there was not much discrimination between average scores; Tables 2 and 3 only show the top ten ranked responses, which is an arbitrary cut-off point. (We encourage readers to look at Supplemental Material, Appendices D & E for detail.) Second, there were some initial linguistic challenges for non-native English speaking respondents when completing the survey. Surveys were translated into a number of languages to address this issue. Third, the responses of global immunization stakeholders are not generalizable to all global stakeholders since this was a convenience sample and respondents may share the same beliefs and experiences (e.g., stakeholders may have forwarded the survey to like-minded colleagues). Similarly, the responses of country immunization stakeholders may not be generalizable to stakeholders from countries not selected for our survey. Lastly, as this study involved personal beliefs, there is potential for social desirability bias, where stakeholders may have indicated that more progress was being made by their immunization program than in reality.

6. Ways to strengthen a post-2020 GVAP strategy

Based on our survey findings and in line with discussions among the global health community [17], the next 10-year plan would be useful if it were able to do some of the following, including but not limited to:

1. *Garner political commitments from global donors and high-level country authorities, in order to increase resources, skilled staff, and public demand for immunization services.*
2. *Align immunization with other initiatives and health system strengthening in general.*
3. *Provide a strong communication and advocacy platform, clarifying partner responsibilities and further engaging partners, donors, and governments in immunization activities.*
4. *Address the growing concerns related to reaching mobile and migrant populations.*
5. *Establish (a few) global goals and indicators, while regions and countries take responsibility for developing strategies to meet global goals.*
6. *Emphasize the importance of disease surveillance as a measure of country progress and as a tool for advocating for immunization activities.*

7. Conclusions

Global, regional, and country immunization stakeholders viewed GVAP as a useful tool even though most of its goals were not fully achieved by 2015 and are unlikely to be met by 2020. There is cause for excitement and hope as the immunization community looks at the positive impact of GVAP (e.g., a common 'brand' for communication and advocacy, a comprehensive reporting mechanism, regular reporting to the World Health Assembly) and forward to a new strategy. Reaching GVAP's new vaccine introduction target in 2015 was a remarkable achievement, one that reflects substantial efforts and collaboration from global partners and national governments. It is up to all countries, with the continuous support of global immunization stakeholders and engagement of NITAGs, CSOs, and private partners, to make the Decade of Vaccines mission—in which all people have the chance to enjoy lives free from vaccine-preventable diseases—a reality. With the proper focus and commitment, the next global strategy could be the means of doing so.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2019.07.042.

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